RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)

DATE: February 2000

BUDGET ACTIVITY: 03 - Advanced Technology Development

PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology

	COST ($ in Thousands)	FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
	Total Program Element (PE) Cost	72,549	102,277	97,327	95,490	83,343	68,837	56,243	Continuing	TBD
631026	Space Structures and Controls Technology	1,648	6,620	0	0	0	0	0	Continuing	TBD
632181	Spacecraft Payloads	10,765	18,076	17,045	17,130	15,194	15,420	16,575	Continuing	TBD
633784	Space Sensors Technology	1,972	2,571	0	0	0	0	0	Continuing	TBD
633834	Integrated Space Technology Demonstrations	33,840	51,074	16,271	17,407	18,174	21,002	19,059	Continuing	TBD
634400	Space Systems Protection	5,573	6,537	1,111	2,329	2,803	3,085	3,563	Continuing	TBD
634844	Discoverer II	14,894	13,098	54,240	50,016	37,608	19,513	6,415	Continuing	TBD
63682J	Spacecraft Vehicles	3,857	4,301	8,660	8,608	9,564	9,817	10,631	Continuing	TBD
	Quantity of RDT&E Articles	0	0	0	0	0	0	0	0	0

Note: Discoverer II funding for FY 1999 was appropriated and is being executed under PE 0603856F, but is being reported here for consistency. Discoverer II funding moved from PE 0603856F to Project 634844 in this PE for FY 2000 and beyond. In FY 2000, the spectral sensing work in PE 0603605F, Project 633150, moves into this PE, Project 633784. Also in FY 2000, PE 0603302F, Project 630003, Launch Vehicle Technology, was combined with Project 631026 in this PE. In FY 2001, several of the smaller projects in this PE were merged; Project 631026 work was moved to Project 63682J, and Project 633784 work was moved to Project 632181.

(U) A. Mission Description

This program develops advanced spacecraft technologies such as structures, electronics, thermal management systems, power, and sensors and demonstrates them in an appropriate fashion (i.e., component or system, ground, or flight). The broad goals of the program are to decrease the time for innovative space technology to be transitioned to the warfighter and to reduce the associated development costs and risks of future Air Force space-based systems. Developmental efforts are focused on six high-payoff, satellite technology areas: (1) reusable and low-cost launch vehicle technologies; (2) advanced space structures and structural controls; (3) radiation hardened space electronics, satellite control software, and intelligent satellite systems; (4) advanced passive/active space-based sensors; (5) compact, low-cost space

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(U) A. Mission Description Continued

power and thermal management; and (6) satellite survivability and protection. In FYs 1999 and out, additional emphasis has been placed on evolutionary growth in space technologies. Also starting in FY 1999, the technology development work supporting the integrated demonstrations of advanced guidance, navigation, and control packages for ballistic missiles is funded by this PE. Note: Congress added $50.8 million in FY 2000 ($3.0 million for Scorpius, $4.0 million for Miniature Threat Reporting System, $5.0 million for Microsat Technology, $15.0 million for Upper Stage Flight Experiment, $15.0 million for Space Maneuvering Vehicle, $5.0 million for Radiation Hardened Microelectronics, $0.8 million for Hyperspectral Imaging, and $3.0 million for Composite Space Launch Payload Dispensers).

(U) B. Budget Activity Justification

This program is in Budget Activity 3, Advanced Technology Development, since it develops and demonstrates technologies for existing system upgrades and/or new system developments that have military utility and address warfighter needs.

(U) C. Program Change Summary ($ in Thousands)

		FY 1999	FY 2000	FY 2001	Total Cost
(U)	Previous President's Budget (FY 2000 PBR)	91,021	76,229	116,300	
(U)	Appropriated Value	76,050	103,529		
(U)	Adjustments to Appropriated Value				
	a. Congressional/General Reductions	-508	-17		
	b. Small Business Innovative Research	-1,710			
	c. Omnibus or Other Above Threshold Reprogram		-561		
	d. Below Threshold Reprogram	-871			
	e. Rescissions	-412	-674		
	f. Other				TBD
(U)	Adjustments to Budget Years Since FY 2000 PBR			-18,973	
(U)	Current Budget Submit/FY 2001 PBR	72,549	102,277	97,327	TBD

(U) Significant Program Changes:

FY 2001 Funding Adjustments: $13.0 million moves from FY 2001 to FY 2002-2003 to better align the Discoverer II demonstration program with requirements. Additional adjustments move funds to support higher Air Force priorities.

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DATE: February 2000

BUDGET ACTIVITY: 03 - Advanced Technology Development

PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology

PROJECT: 631026

COST ($ in Thousands)		FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
631026	Space Structures and Controls Technology	1,648	6,620	0	0	0	0	0	Continuing	TBD

(U) A. Mission Description

This project demonstrates advanced composite structures and structural control technologies for future Air Force space and missile systems. Prior to FY 1995, the Air Force relied on Ballistic Missile Defense Organization (BMDO) funding to address its needs in this technology area. As BMDO budgets have declined, so has their funding in this area, necessitating an increased Air Force investment to maintain critical spacecraft structures and controls technologies. Advanced space structure component efforts focus on the demonstration of new composite structure technologies. The goal is to significantly improve the payload mass fraction and reduce overall spacecraft fabrication time and cost. This project also pays for the development of advanced passive and active spacecraft structural control technologies. Structural vibration and shock suppression technologies are intended to significantly enhance space platform stability, improving the focusing/imaging ability of space-based optical components such as focal plane arrays developed in Project 633784 or solar cells developed in Project 63682J.

(U) FY 1999 ($ in Thousands)

(U) $745 Developed composites for launch vehicle and spacecraft structures for applications such as the lightweight space antenna. Developed spacecraft to demonstrate multifunctional structures technologies.

(U) $258 Developed revolutionary spacecraft structural control and mechanisms technologies for applications such as advanced high power solar array subsystems, sensitive payload isolation systems, and miniature payload isolation systems for sensors and communication systems.

(U) $645 Developed launch vibration isolation and primary and secondary payload isolation systems to meet specific launch vehicle requirements.

(U) $1,648 Total

(U) FY 2000 ($ in Thousands)

(U) $1,561 Develop composites for launch vehicle and spacecraft structures for applications such as the lightweight space antenna. Develop spacecraft to demonstrate multifunctional structures technologies. Composite and multifunctional structures will be lighter and more affordable, with improved functionality, reducing fabrication and launch costs and enabling applications such as large aperture sensing systems. Develop spacecraft to demonstrate inflatable and multifunctional structures technologies and fabricate inflatable and multifunctional structures for launch. Develop subscale secondary payload adapter structure.

(U) $389 Develop and demonstrate revolutionary spacecraft structural control and mechanisms technologies for on-orbit applications such as advanced high power solar array subsystems, sensitive payload isolation systems, and miniature payload isolation systems for sensors and communications systems. These technologies will enhance platform stability, enabling applications such as precision pointing and sensing systems, as well as protect payloads on orbit and increase payload lifetime. Design miniature vibration suppression systems. Launch complex sensor isolation

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(U) A. Mission Description Continued

(U) FY 2000 ($ in Thousands) Continued

platform for demonstration of vibration isolation and pointing. Launch second sensor isolation platform, which is simpler and more user friendly. Continue development of passive and active acoustic attenuation technologies.

(U) $1,136 Develop launch vibration isolation and primary and secondary payload isolation systems to meet specific launch vehicle requirements. Isolation systems will reduce the launch environment problems, decrease spacecraft weight, and reduce failures. Demonstrate low shock separation systems on ground and in flight. Flight demonstrate first three-axis small launch vehicle isolation system.

(U) $570 Develop advanced composite launch vehicle structures such as grid stiffened shrouds for launch vehicles and lightweight thermal protection structures for reusable launch vehicles. Define technological needs for futures military launch vehicles. Composite structures will be lighter and more affordable, reducing fabrication and launch costs, and allowing larger and heavier payloads to be placed in higher orbits. Develop operational grid-stiffened structures.

(U) $2,964 Develop composite space launch payload dispenser for whole-constellation microsatellite deployment. Payload dispenser technologies will satisfy short- and long-term launch needs by making use of excess Enhanced Expendable Launch Vehicle (EELV) capacity. Design and fabricate high stiffness composite constellation payload dispenser.

(U) $6,620 Total

(U) FY 2001 ($ in Thousands)

(U) $0 Efforts transferred to Project 63682J.

(U) $0 Total

(U) B. Project Change Summary

Not Applicable.

(U) C. Other Program Funding Summary ($ in Thousands)

(U) Related Activities:

(U) PE 0602102F, Materials.

(U) PE 0602601F, Spacecraft Technology.

(U) PE 0603218C, Research and Support.

(U) PE 0603302F, Space and Missile Launch Technology.

(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

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BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
03 - Advanced Technology Development	0603401F Advanced Spacecraft Technology	631026

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)

DATE: February 2000

BUDGET ACTIVITY: 03 - Advanced Technology Development

PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology

PROJECT: 632181

COST ($ in Thousands)	FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
632181 Spacecraft Payloads	10,765	18,076	17,045	17,130	15,194	15,420	16,575	Continuing	TBD

(U) A. Mission Description

This project funds the development, demonstration, and evaluation of radiation hardened space electronic hardware, and satellite control hardware and software for advanced satellite surveillance operations. Improved space-qualifiable electronics and software for data and signal processing are to be more interchangeable, interoperable, and standardized. In the near-term, this project's work concentrates on converting (i.e., hardening) commercial data and signal processor technologies for use in Air Force space systems. Advanced electronic packaging technologies that reduce weight and volume are being developed for military space applications. Space data processor technologies like the Advanced Technology Insertion Module (ATIM 32-bit) technology are developed and demonstrated. The Advanced Spaceborne Computer Module (ASCM), ATIM's 16-bit predecessor, is currently baselined into 65 DoD, National Aeronautics and Space Administration (NASA), and commercial programs. Also developed and demonstrated are space signal processor technologies like the Hardened Ada Signal Processor (HASP) program. For mid-term applications, the Improved Space Computer Program (ISCP) will merge advanced, radiation-hardened space processor, memory, and interconnect technologies with commercially-derived, open system architectures to develop and demonstrate robust, on-board processing capabilities for 21st century DoD satellites. Additionally, this project demonstrates very low-power electronics allowing dramatic size, weight, and power reductions for future Air Force space applications. Low-cost, easily modifiable software and hardware architectures for enhanced satellite ground control and intelligent, autonomous satellite operations to support the space surveillance mission are also developed. The Multi-mission Advanced Ground Intelligent Control (MAGIC) program in this project developed a low-cost, flexible architecture for satellite control and mission operations. In the long-term, this project area focuses on developing fully autonomous constellations of intelligent satellites capable of performing all mission related functions without operator intervention.

(U) FY 1999 ($ in Thousands)

(U)	$8,115	Developed and demonstrated affordable, space-qualifiable, radiation hardened, low-power, high performance microelectronic devices such as advanced data processors, and integrated and next generation digital signal processors.
(U)	$1,076	Developed space-qualifiable, high density advanced packaging technology for digital, analog, and mixed-signal electronic devices. Developed micro-electro-mechanical systems (MEMS) components and MEMS-based space system applications.
(U)	$744	Developed enhanced satellite flight software for application to autonomous distributed satellite formation flying, signal processing, and control.
(U)	$830	Developed modeling and simulation applications for space-based surveillance and distributed satellite system payloads.
(U)	$10,765	Total

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(U) A. Mission Description Continued

(U) FY 2000 ($ in Thousands)

(U) $8,731 Develop advanced radiation hardened microelectronic devices such as advanced space data processors and ultra-high density strategically hardened memories for next generation high performance on-board space electronics. Improve radiation hardened fabrication technologies for component manufacturability. Perform functional proof of design of radiation hardened Power PC processor. Redesign commercial next generation space processor, accounting for single event upsets, 10X reduction in amount of power required per instruction at a central processing unit (CPU) level, and radiation hardened fabrication. Provide software and hardware-in-the-loop simulators for advanced, user definable space processor architecture.

(U) $1,421 Develop space-qualifiable, high density advanced packaging technology for digital, analog, and mixed-signal electronic devices and micro-electro-mechanical system (MEMS) components and applications, including switches and optical components which exploit MEMS technologies. These technologies decrease size, weight, and power required for space electronic devices while improving performance, reliability and affordability. Design two-dimensional and three-dimensional space qualified packaging technologies and reconfigurable electronics and plug-and-play system approaches for space. Develop technologies to enhance/enable optical cross-links such as light-emitting diodes, laser diodes, and MEMS optics that allow 400 Megabit/second data transfer.

(U) $2,100 Develop intelligent satellite system technologies for satellite control, precision spacecraft navigation, formation flying, and cluster management technologies for spacecraft constellations. Intelligent satellite systems provide improved capabilities to monitor satellites in real-time, reduce time required for data collection, processing, and dissemination, and decrease anomaly resolution time and ground operation requirements. Design satellite cluster command and control, cluster formation flying, and executive cluster control software. Continue design of ground simulation testbed. Complete agent-based software architecture to increase satellite autonomy and simplify the development of complex systems. Demonstrate initial formation flying and orbit determination and satellite control ground station software.

(U) $884 Develop simulation, modeling, and analysis (MS&A) tools for space-based surveillance systems and distributed satellite architecture payloads. MS&A tools provide data and validate research and development (R&D) systems engineering level technology trade off decisions for space-based surveillance missions/campaign level assessments and for intelligent satellite systems testbeds. Deliver Next Generation Space Telescope simulation. Develop existing space surveillance simulations to support New World Vista's Global Awareness Virtual Testbed. Deliver enhanced satellite toolkit which encompasses satellite constellation-level, distributed architecture modeling.

(U) $4,940 Develop key radiation hardened microelectronics processes and components for space applications. Improved processes and higher performance components will create new markets and strengthen the radiation hardened electronics industrial base, ensuring component availability at reasonable cost. Improve fabrication process for, and performance of, radiation hardened Application Specific Integrated Circuits; fabricate and validate evaluation chips. Fabricate high performance, strategic hardened microprocessors (PowerPC 603e equivalent) for space using hardened design techniques and transfer to hardened manufacturing fabrication line. Design and fabricate a 16Mbit radiation hardened memory - a 4X

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(U) A. Mission Description Continued

(U) FY 2000 ($ in Thousands) Continued

improvement over current technologies - using innovative techniques and new material application.

(U) $18,076 Total

(U) FY 2001 ($ in Thousands)

(U) $9,104 Develop advanced radiation hardened microelectronic devices, including space data processors and ultra-high density strategically hardened memories, space-qualifiable, high density advanced packaging technology for digital, analog, and mixed-signal electronic devices, and micro-electro-mechanical systems (MEMS) components and applications, such as switches and optical components. These devices and technologies enable next generation high performance, small, lightweight, efficient, and reliable on-board space electronic systems. Fabricate and demonstrate radiation hardened Power PC. Insert Next Generation Space Processor design and hardware into flight demonstration system. Design specifications, build, and demonstrate ground-based computer based on Improved Space Architecture concept. Demonstrate MEMS switches for reconfigurable space electronic applications. Continue development of packaging and MEMS technologies to enhance/enable optical cross-links and demonstrate the 400 Megabit/second data transfer. Develop reconfigurable electronics and initial plug-and-play system approaches for space.

(U) $1,584 Continue to develop intelligent satellite system technologies for satellite control, precision spacecraft navigation, formation flying, and cluster management technologies for spacecraft constellations. Intelligent satellite systems provide improved capabilities to monitor satellites in real-time, reduce data collection, processing, and dissemination time, and decrease anomaly resolution time and ground operation requirements. Demonstrate intelligent satellite software in the completed ground testbed for satellite cluster command and control, cluster formation flying, and executive cluster control. Demonstrate enhanced executive cluster controller and deliver final formation flying and orbit determination flight test software and satellite control ground station software.

(U) $1,448 Continue to develop modeling, simulation, and analysis (MS&A) tools and data exploitation methodologies for space-based surveillance systems and distributed satellite architecture payloads. The MS&A tools provide data and validate research and development (R&D) systems engineering level technology trade off decisions for space-based surveillance missions/campaign level assessments and for intelligent satellite systems testbeds. Deliver simulation architecture tools for satellite constellation-level modeling and validate these tools across the broader modeling and simulation space community. Demonstrate existing space surveillance simulations to support New World Vista's Global Awareness Virtual Testbed. Demonstrate MS&A software and tools in the distributed satellite architecture simulation testbed. Complete exploitation of the hyperspectral imaging data received from the Fourier Transform Hyperspectral Imager payload and assemble data images for target identification and image evaluation for commercial and military purposes.

(U) $2,227 Develop advanced space infrared sensors and hardened focal plane detector arrays to enable acquisition, track, and discrimination of hot targets, as well 'cold body' targets such as decoys, satellites, and midcourse warheads. Design low temperature multicolor and low background sensors

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(U) A. Mission Description Continued

(U) FY 2001 ($ in Thousands) Continued

with focal plane arrays, higher temperature focal plane array sensors, and higher performance radiation hardened sensors. Develop longer wavelength mercury cadmium telluride focal plane arrays, higher operating temperatures for mid-wavelength infrared focal plane arrays, and focal plane arrays with optimal background-limited performance for stressing, low photon noise, space backgrounds.

(U) $2,682 Develop satellite antenna technologies which maximize the use of high density interconnects, embed the electronics directly onto the antenna itself, and use antenna modules create large, light space antennas. Satellite antenna technologies will be used to improve affordability and capability of antenna modules for space-based payload subsystems for Air Force surveillance and navigation efforts. Complete design of selected embedded-structural transmit-receive electronics antenna modules. Design antenna modules which address the requirement for minimizing mass and power by embedding lightweight electronics in the structure itself. Continue fabrication of modular phased array antenna tile. Complete data analysis on receive-only sub-antenna array data.

(U) $17,045 Total

(U) B. Project Change Summary

Not Applicable.

(U) C. Other Program Funding Summary ($ in Thousands)

(U) Related Activities:
(U) PE 0303601F, MILSTAR Satellite Communications System.
(U) PE 0305160F, Defense Meteorological Satellite Program (DMSP).
(U) PE 0602601F, Spacecraft Technology.
(U) PE 0603311F, Ballistic Missile Technology.
(U) PE 0603215C, Limited Defense System
(U) PE 0603218C, Research and Support.
(U) PE 0603226E, Experimental Evaluation of Major Innovative Technologies.
(U) PE 0604609F, Reliability and Maintainability Technology Insertion Program (RAMTIP).
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

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(U) E. Schedule Profile Continued

(U) Not Applicable.

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PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology

PROJECT: 633784

COST ($ in Thousands)	FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
633784 Space Sensors Technology	1,972	2,571	0	0	0	0	0	Continuing	TBD

(U) A. Mission Description

This project funds the development of military space-based ground surveillance technologies. The project's work focuses on advancing space-based applications of commercial sensors while improving the performance, schedule, maturity, cost, and/or risk reduction. The focus of the space sensor effort is to meet spaceborne sensor needs for national missile defense and intelligence, surveillance, and reconnaissance missions.

(U) FY 1999 ($ in Thousands)

(U) $248 Developed and demonstrated space-based reconnaissance/surveillance sensor technologies for advanced mid-wave infrared detectors and hybrid detector arrays.

(U) $1,559 Developed technologies for Space-Based Radar (SBR) Air Moving Target Indication (AMTI) Transmit and Receive Antenna Module (TRAM), antenna beamsteering algorithms for improved detection and tracking, and antenna vibration compensation schemes.

(U) $165 Developed models for the SBR AMTI.

(U) $1,972 Total

(U) FY 2000 ($ in Thousands)

(U) $1,404 Develop advanced space infrared sensors and hardened focal plane detector arrays to enable acquisition, track, and discrimination of hot targets, as well as 'cold body' targets such as decoys, satellites, and midcourse warheads. Continue development of radiation hardened mercury cadmium telluride 128 x 128 focal plane array. Develop 1024 x 1024 long wavelength mercury cadmium telluride focal plane array. Demonstrate feasibility of a polarization autocue for focal plane arrays. Characterize performance of higher temperature multispectral infrared focal plane arrays.

(U) $459 Develop satellite antenna technologies which maximize the use of high density interconnects, embed the electronics directly onto the antenna itself, and use antenna modules create large, light space antennas. Satellite antenna technologies will be used to improve affordability and capability of antenna modules for space-based payload subsystems for Air Force surveillance and navigation efforts. Design selected embedded-structural transmit-receive electronics antenna modules. Address requirement for minimizing mass and power by embedding lightweight electronics in the antenna structure itself. Fabricate a modular phased array antenna tile. Complete fabrication and launch receive-only sub-antenna array and begin data analysis.

(U) $708 Develop hyperspectral imaging data exploitation methodologies for military remote sensing applications with the Fourier Transform HyperSpectral Imager (FTHSI). The FTHSI payload will demonstrate the capability of providing the warfighter data concerning terrain

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(U) A. Mission Description Continued

(U) FY 2000 ($ in Thousands) Continued

categorization, feature extraction, geological formation mapping, and trafficability within an area observed from space. Launch the FTHSI payload on-board the MightySat II.1 satellite. Initiate analysis of the hyperspectral imaging data received from the Fourier Transform HyperSpectral Imager (FTHSI) payload. Begin assembly of data images for target identification and image evaluation for commercial and military purposes.

(U) $2,571 Total

(U) FY 2001 ($ in Thousands)

(U) $0 Efforts transferred to Project 632181.

(U) $0 Total

(U) B. Project Change Summary

Not Applicable.

(U) C. Other Program Funding Summary ($ in Thousands)

(U) Related Activities:

(U) PE 0303601F, MILSTAR Satellite Communications System.

(U) PE 0602601F, Spacecraft Technology.

(U) PE 0602702F, Command/Control/Communication Technology.

(U) PE 0603226E, Experimental Evaluation of Major Innovative Technologies.

(U) PE 0604711F, Extremely High Frequency Satellite Communications Research and Development.

(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.

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PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology

PROJECT: 633834

COST ($ in Thousands)		FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
633834	Integrated Space Technology Demonstrations	33,840	51,074	16,271	17,407	18,174	21,002	19,059	Continuing	TBD

(U) A. Mission Description

The Integrated Space Technology Demonstration (ISTD) program is a series of advanced technology demonstrations designed to address the Air Force Space Command (AFSPC) mission needs, as identified through their Integrated Planning Process, by applying emerging technologies from the Air Force Research Laboratory, other Government laboratories, and industry. These technologies are integrated into system level demonstrations that are used to test, evaluate, and validate the technologies in an operational environment, while at the same time affording the user community the opportunity to assess the technologies and determine their applicability to specific operational needs. The ISTD program is intended to fly these demonstrations on three year centers (launch to launch) in order to ensure that the technologies are state-of-the-art, as well as relevant to current mission needs. The program attempts to leverage DoD, civil, and commercial space systems in order to reduce the cost of the demonstrations. Warfighter-1, for example, leverages ORBIMAGE's Orbview-4 commercial remote sensing spacecraft to fly a hyperspectral sensor. Leveraged programs offer additional insight into how the civil and commercial space systems can be exploited to provide operational capability at a fraction of the cost of dedicated military systems.

(U) FY 1999 ($ in Thousands)

(U)	$18,794	Developed and integrated components for the Warfighter-1 ISTD Program, including payload and mobile ground station components and the modified data exploitation algorithms.
(U)	$992	Defined concept and developed acquisition strategy for Warfighter-2 ISTD Program.
(U)	$928	Developed advanced precision ballistic missile navigation technologies to support range instrumentation and safety requirements, improve accuracy after reentry, and support conventional weapon delivery systems.
(U)	$5,828	Developed technologies for autonomous and manual on-orbit control of microsatellites and for autonomous microsatellite navigation and inspection. Conducted the XSS-10 flight demonstration of a microsatellite to demonstrate the 'proof of principle'.
(U)	$2,429	Developed the two-stage near-orbital demonstrator for low-cost liquid launch vehicle technologies.
(U)	$4,869	Developed and tested technologies for solar orbital transfer vehicles (SOTV) such as high performance thermionic energy converters and high temperature insulation materials. Developed preliminary design of a space experiment to validate key solar orbital transfer vehicle technologies such as thermionic energy converters, lightweight solar concentrators, and cryogenic propellant systems.
(U)	$33,840	Total

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(U) A. Mission Description Continued

(U) FY 2000 ($ in Thousands)

(U)	$12,141	Develop Warfighter-1, the first in a series of Integrated Space Technology Demonstration systems. Warfighter-1 will provide an inexpensive space-based hyperspectral imagery system for technology validation by the user in a tactical environment. Hyperspectral imaging sensors provide improved capabilities for the warfighter in target detection, terrain classification, and related surveillance applications. Complete development of the Warfighter-1 hyperspectral sensor, mission data center, and mobile ground station. Perform sensor characterization and integration and test on the payload, spacecraft, and space vehicle. Prepare for FY 2001 launch.
(U)	$599	Develop and demonstrate precision ballistic missile navigation technologies to improve accuracy during reentry and in plasma and jamming environments. These technologies will mitigate the detrimental effects of reentry plasma and jamming on Global Positioning System (GPS) navigation performance. Conduct reentry plasma physics characterization studies and start development of miniaturized jam-resistant GPS receivers.
(U)	$790	Develop hyperspectral imaging technologies for space-borne assets to provide improved capabilities for the warfighter in target detection, terrain classification, and related surveillance applications. Complete development of the Warfighter-1 hyperspectral imaging sensor payload on-board processing capability.
(U)	$4,940	Develop microsatellite (10-100kg) technologies and integrated microsatellite technology concepts. Microsatellite technologies will revolutionize satellite operations and support applications such as near-earth object inspection and satellite servicing. Launch first microsatellite in the XSS microsatellite series to test autonomous microsatellite operations including satellite inspection.
(U)	$2,964	Develop scalable booster technologies for low-cost launch vehicles. These technologies will reduce launch vehicle life cycle cost by 5-10X. Demonstrate the Sprite orbital vehicle for launching Air Force small payloads at significantly reduced cost. Develop and test 20,000-lb. thrust flight-weight ablative Sprite booster engine. Design, fabricate, and test prototype Sprite 2K upper stage engine. Demonstrate hydroxy ammonium nitrate tetraethylammoniumnitrate (HANTEAN) mixing gas generator tank pressurization technology.
(U)	$14,820	Develop and demonstrate technologies for a military unique reusable satellite bus and upper stage for the Military Spaceplane system. This effort will provide the Air Force with a vehicle for demonstrating critical Air Force technologies and concept of operations. Develop technologies for a second tail number, leveraging the technology investment in the NASA X-37, and address specific Air Force requirements including space operations and operability technologies.
(U)	$14,820	Develop and demonstrate a low-cost, liquid propellant, expendable upper stage in a cooperative effort with NASA. These technologies will meet Air Force requirements for an affordable expendable upper stage for the Military Spaceplane system, including non-toxic, storable liquid propellants. Prepare for launch in FY 2001.
(U)	$51,074	Total

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(U) A. Mission Description Continued

(U) FY 2001 ($ in Thousands)

(U)	$6,482	Develop Warfighter-1, the first in the series of Integrated Space Technology Demonstration (ISTD) systems. Warfighter-1 will provide an inexpensive space-based hyperspectral imagery system for technology validation by the user in a tactical environment. Space-based hyperspectral imaging sensors provide improved capabilities for the warfighter in target detection, terrain classification, and related surveillance applications. Perform launch operations and start on-orbit evaluation of the hyperspectral sensor and associated ground operations. Conduct Warfighter-1 user utility demonstrations, satellite technology validation, and data exploitation analysis and assessment. Start final report detailing the evaluation and lessons learned from the technology demonstration and commercial leveraging.
(U)	$4,585	Develop the second ISTD system. This demonstration will provide the warfighter a cost-effective means of evaluating one of the competing mission concepts. Select the mission concept and develop the technical requirements and acquisition strategy. Execute acquisition plan for a fourth quarter FY 2001 contact award. Begin fabrication of demonstration system components.
(U)	$138	Develop and demonstrate precision ballistic missile navigation technologies to improve accuracy during reentry and in plasma and jamming environments. These technologies will mitigate the detrimental effects of reentry plasma and jamming on Global Positioning System (GPS) navigation performance. Conduct reentry plasma physics characterization and demonstration planning, and continue development and demonstration of miniaturized jam-resistant GPS receivers.
(U)	$2,978	Develop microsatellite (10-100kg) technologies and integrated microsatellite technology concepts. Microsatellite technologies will revolutionize satellite operations and support applications such as near-earth object inspection and satellite servicing. Begin design of second satellite in the XSS microsatellite series. Study bus requirements and potential designs. Develop Johnson Space Center GPS and proximity operations sensor package.
(U)	$2,088	Develop technologies for the Communications/Navigation Outage Forecasting System (C/NOFS) demonstration. C/NOFS will demonstrate the capability for forecasting outages to GPS navigation and satellite communications links, providing the warfighter with information on communications and navigation outages, allowing preemptive use of backup systems and alternate links, aiding anomaly resolution, and facilitating mission /operations planning. Develop data processing unit. Verify payload interface. Support spacecraft development and pre-planning of sensor suite integration and testing.
(U)	$16,271	Total

(U) B. Project Change Summary

Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)	DATE
	February 2000

BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
03 - Advanced Technology Development	0603401F Advanced Spacecraft Technology	633834

(U) C. Other Program Funding Summary ($ in Thousands)

(U) Related Activities:

(U) PE 0602601F, Spacecraft Technology.

(U) PE 0603605F, Advanced Weapons Technology.

(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)

DATE: February 2000

BUDGET ACTIVITY: 03 - Advanced Technology Development

PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology

PROJECT: 634400

COST ($ in Thousands)	FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
634400 Space Systems Protection	5,573	6,537	1,111	2,329	2,803	3,085	3,563	Continuing	TBD

(U) A. Mission Description

This project funds the development and demonstration of technologies required to assure operation of U.S. space assets in potentially hostile warfighting environments. Work performed includes assessment of critical components, subsystems, and systems' threat susceptibility and vulnerability. This project also develops technologies to mitigate identified vulnerabilities. Further, technology options are developed and demonstrated to support balanced satellite protection strategies for detecting, avoiding, and operating in a hostile space environment. Efforts under this project will be closely integrated with exploratory space technologies such as those developed under PE 0602601F, Projects 621010 and 628809, and advanced space technologies developed under this PE in Projects 631026, 632181, 633784, and 63682J. Where appropriate, end products include integrated demonstrations with technologies developed in Project 633834. Through this project, the Air Force assumes responsibility for critical spacecraft survivability technology from the Ballistic Missile Defense Organization (BMDO).

(U) FY 1999 ($ in Thousands)

(U) $139 Expanded the capability of the multi-threat assessment tool by adding selected directed energy effects.

(U) $139 Completed countermeasure analysis task, examining weight and power improvements.

(U) $435 Completed fabrication and began testing of the radio frequency (RF) threat warning/attack reporting (TW/AR) receiver.

(U) $4,860 Prepared radar warning receiver miniaturization for power and weight savings for the Miniaturized Satellite Threat Reporting System (MSTRS). Began preparation for the MSTRS risk reduction prototype hardware space flight scheduled for shuttle flight STS-107.

(U) $5,573 Total

(U) FY 2000 ($ in Thousands)

(U) $1,255 Prepare and use multi-threat assessment tool to assess space-based electro-optical sensor responses to various candidate laser countermeasures. Provides space platform designers a rapid and robust assessment tool for accurate assessment of various countermeasures. Identify passive satellite countermeasures and develop appropriate mitigation techniques.

(U) $553 Develop satellite threat warning technologies and tools for on-board satellite use to detect, geolocate, and characterize the receipt of intentional and unintentional ground-based RF and laser signals. Satellite threat warning technologies provide the warfighter information related to possible hostile acts directed at mission critical satellites and aid in satellite anomaly resolution. Fabricate and test space-qualified RF hardware and develop proof of concept laser sensor design and laboratory brassboard.

(U) $777 Coordinate integration and testing of MSTRS on host experiment platform for Space Shuttle risk reduction flight. The flight test will provide engineering performance analysis of key MSTRS hardware components in a space environment and provide users early insight into MSTRS

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BUDGET ACTIVITY 03 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT 634400

(U) A. Mission Description Continued

(U) FY 2000 ($ in Thousands) Continued

operational performance characteristics.

(U) $3,952 Continue evolution of Miniaturized Satellite Threat Reporting System (MSTRS) that warns against ground-based, broad-band Radio Frequency (RF) threats to satellites using a radar warning receiver as well as meakoning, intrusion, jamming, and interference receivers. Miniaturization enables incorporation of threat warning technologies on a variety of space platforms. Develop receiver system miniaturization technologies for power and weight savings.

(U) $6,537 Total

(U) FY 2001 ($ in Thousands)

(U) $50 Use multi-threat assessment tool to assess space-based electro-optical sensor responses to various candidate laser countermeasures. Provides space platform designers a rapid and robust assessment tool for accurate assessment of various countermeasures. Begin development of passive satellite countermeasures and appropriate mitigation techniques.

(U) $665 Continue to develop satellite threat warning technologies and tools for on-board satellite use to detect, geolocate, and characterize the receipt of intentional and unintentional ground-based RF and laser signals. Satellite threat warning technologies provide the warfighter information related to possible hostile acts directed at mission critical satellites and aid in satellite anomaly resolution. Complete design, fabricate, and test laser sensor brassboard. Begin design of integrated prototype RF receiver/laser sensor hardware with weight and power savings compared to individual sensor packages.

(U) $396 Develop RF threat warning receiver for a one-year long space flight. Complete Radio RF receiver data analysis, evaluate receiver performance to identify design changes to optimize performance, and incorporate changes into receiver design to reduce performance risk for the one-year flight. Conduct assessment of weapons effects on satellite components and systems.

(U) $1,111 Total

(U) B. Project Change Summary

Not Applicable.

(U) C. Other Program Funding Summary ($ in Thousands)

(U) Related Activities:

(U) PE 0602102F, Materials.

(U) PE 0602601F, Spacecraft Technology.

(U) PE 0603410F, Space Systems Environmental Interactions Technology.

(U) PE 0603605F, Advanced Weapons Technology.

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BUDGET ACTIVITY 03 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology
	PROJECT 634400

(U) C. Other Program Funding Summary ($ in Thousands)

(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)

DATE: February 2000

BUDGET ACTIVITY: 03 - Advanced Technology Development

PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology

PROJECT: 634844

COST ($ in Thousands)	FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
634844 Discoverer II	14,894	13,098	54,240	50,016	37,608	19,513	6,415	Continuing	TBD

(U) A. Mission Description

Discoverer II (D-II) is a space-based radar/ground moving target indicator (SBR/GMTI) risk-reduction demonstration. The program, a two-satellite technical demonstration recommended by the Defense Science Board, develops and demonstrates the technologies that would be inherent in an SBR/GMTI tactical surveillance architecture. The cost goal of the program is to enable affordable acquisition of an operational SBR architecture for worldwide surveillance and targeting by mitigating the technical risks through the D-II demonstration. The National Reconnaissance Office (NRO) is an investment partner in this project and submits its budget request under the 'Discoverer II MTI Demo'. The Defense Advanced Research Projects Agency (DARPA) is also a funding partner due to the technical innovation and development nature of D-II. DARPA submits its budget request under the 'Aerospace Surveillance Technologies, Project SGT-02'. The Air Force also budgets for the launch integration and vehicle costs under PE 0305953F, Evolved Expendable Launch Vehicle. A senior oversight group consisting of SAF/AQ, the Director of NRO, and the Director of DARPA oversees D-II. The Air Force has the Senior Acquisition Executive responsibilities and DARPA has Program Executive Officer responsibilities (through Critical Design Review (CDR)).

(U) FY 1999 ($ in Thousands)

(U) $7,068 Supported jointly funded effort to conduct design trades and analyses leading to candidate objective system and demonstration system designs by awarding three system integration (SI) contracts. Core activities focused on cost/performance trades and completion of an Integrated Master Plan/Schedule. The initial Interim Evaluation Review was conducted in fourth quarter FY 1999.

(U) $7,076 Supported jointly funded risk reduction efforts in key risk areas to include antenna design and fabrication, and exploitation software. Completed Thinned Transmitter/Receiver (T/R) Module Electronically Scanned Array Design.

(U) $750 Conducted mission utility analysis and concept of operations studies.

(U) $14,894 Total

(U) FY 2000 ($ in Thousands)

(U) $8,413 Support jointly funded effort to complete objective system and demonstration system preliminary designs through conduct of a competitive downselect process culminating in selection of a single System Integrator contractor's design. Conduct risk mitigation and demonstration test planning.

(U) $4,685 Support jointly funded risk reduction efforts in key risk areas to include: design and fabrication for a low-cost, lightweight, space-qualifiable, Electronically Scanned Array antenna; and advanced signal processing for High-Range-Resolution Ground Moving Target Indicators, high resolution Synthetic Aperture Radar mode imaging, and terrain mapping technical feasibility and implementation concerns for Digital Terrain

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(U) A. Mission Description Continued

(U) FY 2000 ($ in Thousands) Continued

Elevation Data. Conduct mission utility analysis and concept of operations studies.

(U) $13,098 Total

(U) FY 2001 ($ in Thousands)

(U) $30,270 Support jointly funded effort to conduct detailed design and long lead procurement for satellite and ground demonstration system. Support risk reduction activities in support of a successful Critical Design Review.

(U) $18,628 Support jointly funded construction and component testing of spacecraft bus and payload. Support jointly funded software testing, integration, test, and data reduction. Support risk reduction activities.

(U) $5,342 Support jointly funded risk reduction efforts in key risk areas to include: design and fabrication for a low-cost, lightweight, space-qualifiable, Electronically Scanned Array antenna; and advanced signal processing for High-Range-Resolution Ground Moving Target Indicators, high resolution Synthetic Aperture Radar mode imaging, and terrain mapping technical feasibility and implementation concerns for Digital Terrain Elevation Data. Conduct mission utility analyses and concept of operations studies.

(U) $54,240 Total

(U) B. Project Change Summary

Not Applicable.

(U) C. Other Program Funding Summary ($ in Thousands)

(U) Related Activities:

(U) PE 0305953F, Evolved Expendable Launch Vehicle.

(U) National Reconnaissance Office (NRO) MTI Radar Technology Project.

(U) SGT-02, DARPA Aerospace Surveillance Technologies.

(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.

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DATE: February 2000

BUDGET ACTIVITY: 03 - Advanced Technology Development

PE NUMBER AND TITLE: 0603401F Advanced Spacecraft Technology

PROJECT: 63682J

COST ($ in Thousands)	FY 1999 Actual	FY 2000 Estimate	FY 2001 Estimate	FY 2002 Estimate	FY 2003 Estimate	FY 2004 Estimate	FY 2005 Estimate	Cost to Complete	Total Cost
63682J Spacecraft Vehicles	3,857	4,301	8,660	8,608	9,564	9,817	10,631	Continuing	TBD

(U) A. Mission Description

This project develops and demonstrates compact, low-cost, spacecraft and ballistic missile power generation, storage, distribution, and thermal management technologies, including cryogenic cooling technologies. Power generation work focuses on lightweight, low-cost, low volume, and survivable solar cell arrays. Energy storage work focuses on lightweight nickel hydrogen (NiH2) and sodium sulfur (NaS) spacecraft batteries and flywheel energy storage systems for extended (five-ten year) satellite missions. Power distribution efforts focus on producing lightweight, high efficiency, standardized power busses for use on future Air Force space programs. This project also funds the development and demonstration of the non-nuclear technologies associated with space nuclear power systems such as power conversion, conditioning, and power system thermal management. In addition, investigations into alternative technologies to increase space vehicle power subsystem performance, lifetime, survivability, and safety while reducing costs/risks are conducted. In FY 1995, the Air Force assumed responsibility for the Ballistic Missile Defense Organization's (BMDO) goal to develop spacecraft thermal management technologies. Examples of this are cryogenic coolers necessary to maintain passive (e.g., infrared focal plane array) sensors in low-light backgrounds through this project.

(U) FY 1999 ($ in Thousands)

(U) $1,474 Developed and evaluated performance of space conventional power generation technologies such as advanced multijunction solar cells, thin film solar cells, and a solar-to-electric converter power system for space operation.

(U) $1,472 Developed space conventional energy storage technologies such as the lightweight flywheel integrated power and attitude control system.

(U) $791 Developed advanced cryocooler technology for application to a 10K cryocooler capable of meeting the load, weight, and power requirements for space-based infrared concepts.

(U) $120 Developed spacecraft thermal management systems such as advanced capillary pumped loop systems.

(U) $3,857 Total

(U) FY 2000 ($ in Thousands)

(U) $1,687 Develop and evaluate performance of space conventional power generation technologies such as multi-junction solar cells, advanced thin film solar cells, lightweight flexible arrays of thin film solar cells, and radiation resistant solar cell modules. Advanced conventional power generation technologies will make more power available for satellites with high power requirements, require less storage for launch, use new and easier methods to deploy, and be lighter and more affordable. Begin development of lightweight flexible arrays of thin film solar cells and radiation resistant solar cell modules. Continue development and evaluation of 35% efficient multi-junction solar cells and 12% efficient thin film solar cells.

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BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
03 - Advanced Technology Development	0603401F Advanced Spacecraft Technology	63682J

(U) A. Mission Description Continued

(U) FY 2000 ($ in Thousands) Continued

(U)	$1,375	Develop space conventional energy storage technologies such as the lightweight flywheel integrated power and attitude control system. These advanced energy storage technologies will reduce energy storage mass, replace separate spacecraft attitude control systems, and enable satellites with high peak power requirements such as space antennas and space-based laser systems. Begin flywheel ground demonstration. Begin development of technologies to increase flywheel safety.
(U)	$1,239	Develop technologies for long-life, efficient, low vibration, lightweight mechanical cryocoolers for space applications at temperatures ranging from 10K to 150K. Cryocoolers enable extended missions for infrared sensor-based space surveillance systems, as well as increase the operational range, life, and reliability of very long wavelength infrared sensors. Complete five-year life cycle test of a 60K cryocooler. Integrate the Reverse Brayton cryocooler into the Hubble telescope. Complete 10K engineering development model cryocooler. Deliver protoflight quality 95K cryocooler.
(U)	$4,301	Total

(U) FY 2001 ($ in Thousands)

(U)	$1,965	Develop and evaluate performance of space conventional power generation technologies such as multi-junction solar cells, advanced thin film solar cells, lightweight flexible arrays of thin film solar cells, and radiation resistant solar cell modules. Advanced conventional power generation technologies will make more power available for satellites with high power requirements, require less storage for launch, use new and easier methods to deploy, and be lighter and more affordable. Continue development of lightweight flexible arrays of thin film solar cells and radiation resistant solar cell modules. Demonstrate thermal to electric conversion cells. Continue evaluation of 35% efficient multi-junction solar cells and 12% efficient thin film solar cells.
(U)	$1,345	Develop space conventional energy storage technologies such as the lightweight flywheel integrated power and attitude control system. These advanced energy storage technologies will reduce energy storage mass, replace separate spacecraft attitude control systems, and enable satellites with high peak power requirements such as space antennas and space based laser systems. Continue flywheel ground demonstration and development of flywheel safety technologies. Begin microflywheel development.
(U)	$1,189	Develop technologies for long-life, efficient, low vibration, lightweight mechanical cryocoolers for space applications at temperatures ranging from 10K to 150K. Cryocoolers enable extended missions for infrared sensor-based space surveillance systems, as well as increase the operational range, life, and reliability of very long wavelength infrared sensors. Fabricate and deliver 10K demonstration cryocooler and optimize technology for application to a 10K protoflight demonstration cryocooler. Complete in-house performance evaluation on the 95K cryocooler.
(U)	$2,276	Develop composites for launch vehicles and spacecraft structures, including grid stiffened launch vehicle shrouds and lightweight thermal protection structures for reusable launch vehicles, and for space applications, such as lightweight space antennas. Develop spacecraft to

RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2A Exhibit)		DATE February 2000
BUDGET ACTIVITY 03 - Advanced Technology Development	PE NUMBER AND TITLE 0603401F Advanced Spacecraft Technology	PROJECT 63682J

(U) A. Mission Description Continued

(U) FY 2001 ($ in Thousands) Continued

demonstrate multifunctional structures technologies. Composite and multifunctional structures will be lighter and more affordable, with improved functionality, reducing fabrication and launch costs and enabling applications such as large aperture sensing systems. Flight demonstrate operational grid stiffened structure. Continue development of inflatable structures. Begin ground test of multi-functional structures. Develop full-scale Evolved Expendable Launch Vehicle (EELV) secondary payload adapter structure.

(U) $1,885 Develop and demonstrate revolutionary spacecraft structural control and mechanisms technologies for on-orbit applications such as advanced high power solar array subsystems, sensitive payload isolation systems, and miniature payload isolation systems for sensors and communications systems. Develop launch vibration isolation and primary and secondary payload isolation systems to meet specific launch vehicle requirements. These technologies will enhance platform stability, enable applications such as precision pointing and sensing, protect payloads on orbit and increase payload lifetime, reduce launch environment problems, decrease spacecraft weight, and reduce failures. Test miniature vibration suppression systems. Develop non-linear payload isolation systems. Ground demonstrate active acoustic attenuation system. Flight demonstrate simplified low shock separation device.

(U) $8,660 Total

(U) B. Project Change Summary

Not Applicable.

(U) C. Other Program Funding Summary ($ in Thousands)

(U) Related Activities:
(U) PE 0602203F, Aerospace Propulsion.
(U) PE 0602601F, Spacecraft Technology.
(U) PE 0603302F, Space and Missile Launch Technology.
(U) PE 0603218C, Research and Support.
(U) PE 0603226E, Experimental Evaluation of Major Innovative Technologies.
(U) This project has been coordinated through the Reliance process to harmonize efforts and eliminate duplication.

(U) D. Acquisition Strategy

Not Applicable.

(U) E. Schedule Profile

(U) Not Applicable.